6.9.4

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, Washington 98101

IN REPLY
REFER TO: OEA-095 September 16, 1999

MEMORANDUM

SUBJECT: Bunker Hill, CLP Metals Analysis, Data Validation
Case: 27168
SDG: MJAK56

FROM: Laura Castrilli, Chemist
Quality Assurance and Data Unit, OEA

TO: Mary Kay Voytilla, Regional Project Manager
Office of Environmental Cleanup

CC: Bruce Woods, Region 10 CLP TPO
Jim Stefanoff, CH2M Hill

The following is a validation of ICP-AES and mercury analyses of nine total water samples from the Bunker Hill project. The analyses were performed following the USEPA Contract Laboratory Program Statement of Work for Inorganics Analysis Multi-media, Multi-Concentration, ILM04.0. Analyses were conducted by Sentinel, Inc, of Huntsville, Alabama. This validation was conducted for the following samples:

MJAK56	MJAK58	MJAK60	MJAK62	MJAK64
MJAK57	MJAK59	MJAK61	MJAK63	

Data Qualifications

The following comments refer to the Sentinel Laboratory's performance in meeting quality control specifications outlined in the *CLP Statement of Work (CLP-SOW) for Inorganic Analysis, rev. ILM04.0.* The comments presented herein are based on the information provided for the review.

1.0 Timeliness - Acceptable

The technical (40 CFR part 136) holding time from the date of collection for mercury in water is 28 days. The holding time for the remaining metals in water is 180 days. The samples were collected between 07/02/99 and 07/06/99. Mercury analyses were completed on 07/19/99. ICP-AES analyses were completed on 08/04/99.

2.0 Sample Preparation - Acceptable

The samples were prepared for mercury and ICP-AES analyses on 07/19/99.

3.0 Calibrations/Calibration Verifications -

The samples were analyzed for mercury by CVAAS on 07/19/99. Initial calibration included one blank and six standards. The curve was linear with a correlation coefficient greater than 0.995.

The samples were analyzed by ICP-AES on 07/31/99 (main analyses) and 08/04/99 (manganese and/or zinc ten fold dilutions). The instrument was standardized according to the analytical method each day of analysis using one blank and a single calibration standard for each element.

All ICP-AES and CVAAS (mercury) calibrations were performed as required and met the acceptance criteria; therefore, no qualification was made on this basis.

Continuing calibration verifications (CCVs) are required before and after sample analysis and after every 10 samples during analysis. Mercury recoveries must be within 80-120%. Other metal recoveries must be within 90-110%. The frequency of analysis of CCVs was met. All ICP-AES and CVAAS (mercury) CCVs (initial and continuing) bracketing reported sample results met the recovery criteria with the exception of zinc (111.2%) in the second CCV (CCV2) of the main ICP analysis.

The sample analyzed just prior to this CCV had a zinc level that required a ten fold dilution to report. The continuing calibration blank (CCB2) ran immediately after CCV2 showed evidence of carry over from zinc (7.21 ug/L). Most reported zinc sample results (MJAK58 and MJAK60 through MJAK64) were bracketed by CCV2. The zinc recovery for CCV3 was within 90-110% while zinc was once again detected in CCB3 (3.9 ug/L). In the reviewer's professional judgement, qualification of the reported zinc results due to the high zinc recovery for CCV2 is not necessary as 1) the CCV recovery of 111.2% was only slightly outside the 110% acceptance criteria and 2) the level of carry over is insignificant when compared to the reported zinc results.

4.0 Laboratory Control Samples - Acceptable

Laboratory Control samples are digested and analyzed along with the samples to verify the efficiency of laboratory procedures. All recoveries associated with reported sample results met the acceptance criteria.

5.0 Blanks -

Procedural blanks were prepared with the samples to show potential

contamination from the digestion or analytical procedure. If an analyte was found in the associated blank, the sample results were qualified if the analyte concentration was less than five times the analytical value in the blank.

Arsenic in the preparation blank and a couple of continuing calibration blanks (CCBs) had negative results with absolute values greater than the detection limit. Barium, calcium, chromium, iron, magnesium, manganese, potassium, sodium, and zinc were detected in one or more ICP-AES continuing calibration blanks (CCBs). Based on blank contamination, associated sample results were qualified as follows:

- aluminum in samples MJAK62 and MJAK64 was qualified 'U'
- arsenic in samples MJAK58 and MJAK60 through MJAK64 was qualified 'UJ'
- barium in sample MJAK63 was qualified 'U'
- chromium in samples MJAK56 and MJAK60 through MJAK64 was qualified 'U'
- sodium in samples MJAK61 and MJAK62 was qualified 'U'

All other sample results were greater than five times the associated blank levels (or were already undetected) and were not qualified based on blank contamination.

6.0 ICP-AES Interference Check Sample -

The interference check sample (ICS) is analyzed by ICP-AES to verify interelement and background correction factors. Analysis is required at the beginning and end of each sample analysis run and recoveries must be between 80% and 120%. All ICS recoveries associated with reported sample results were within the recovery criterion.

The raw data for a number of samples had interfering levels of iron and/or manganese. Analytes for which iron and/or manganese is an interferent were qualified as follows:

- Aluminum in sample MJAK60 was qualified 'J', estimated (unknown bias due to suspected manganese interference). Aluminum in samples MJAK62 through MJAK64 was qualified 'UJ', estimated detection limit (possible false positives/unknown bias due to high manganese). Analyte equivalents in Table 2 of ILM04.0 were used to estimated the interference with aluminum due to manganese at levels > 50 mg/L.

- Chromium in samples MJAK56, MJAK57, MJAK59, MJAK60, MJAK62, MJAK63, and MJAK64 was qualified 'UJ', estimated detection limit (possible false positives/unknown bias due to high manganese and for most samples, associated blank contamination). Analyte equivalents in Table 2 of ILM04.0 were used to estimated the interference with chromium due to manganese at levels > 50 mg/L.

- Selenium in sample MJAK56 was qualified 'UJ', estimated detection

limit (possible false negative due to high iron). Selenium in both of the ICS-A analyses bracketing this sample had negative results with absolute values greater than the detection limit.

- Vanadium in samples MJAK56, MJAK57, MJAK59, and MJAK60 was qualified 'UJ', estimated detection limit (possible false negatives due to high iron). Vanadium in both of the ICS-A analyses bracketing these samples had negative results with absolute values greater than the detection limit.

Some of the samples required one or more dilution runs to report zinc, and/or manganese results within the instrumental linear range. The raw data for all analytes were compared using the available dilutions to see if 1) zinc and/or manganese levels in the undiluted samples were high enough that interelement corrections may not be sufficient for the analytes that were reported from the undiluted analysis or 2) a pattern of suppression or enhancement was evident.

This review was limited to an assessment of just cadmium, iron, manganese, lead, and zinc results. No further qualification was made based on this assessment.

7.0 Duplicate Analysis - Acceptable

Duplicate analyses were done on sample MJAK57. Water duplicate results were within the ±20% Relative Percent Difference (RPD) or ±CRDL criteria for water results < 5 times the CRDL criteria. No qualification was made based on duplicate results.

8.0 Field Duplicate Analysis - Not Applicable

Field duplicate analysis for samples in this SDG was not indicated in the field collection documentation.

9.0 Matrix Spike Analysis -

Matrix spike sample analyses are done to provide information about the effect of the sample matrix on digestion and measurement methods. Matrix spike recovery must be within the limits of 75 - 125%.

Matrix spike analyses were done on sample MJAK57. All matrix spike recoveries were within the required QC limits, with the exception of barium (41%), selenium (152%), and silver (73%). All barium and silver results were qualified 'J', estimated (possible low bias for most results, unknown bias for barium in sample MJAK63 as barium in this sample was also qualified due to blank contamination). All detected selenium results were qualified 'J', estimated (possible high bias for most detected results, unknown bias for sample MJAK56 which was also qualified due to suspected interference).

10.0 Graphite Furnace Atomic Absorption Spec (GFAAS) QC - Not Applicable -

GFAAS was not used for the analysis of these samples.

11.0 ICP-AES Serial Dilution -

Sample MJAK57 was analyzed by ICP-AES serial dilution to check for potential interferences. All analytes which exceeded the minimum concentration criterion (50 times the IDL) agreed within the 10%D criteria; with the exception of arsenic (13%) and cadmium (328%). All arsenic and cadmium results were qualified 'J', estimated due to the serial dilution results; with the exception of arsenic in samples MJAK56 and MJAK57. Arsenic was not qualified in these two samples as the ten fold dilution analyses for manganese and/or zinc had arsenic results that agreed within 10%D with the undiluted arsenic results.

12.0 Detection Limits - Acceptable

Sample results which fall below the instrument detection limit (IDL) are assigned the value of the instrument detection limit and the 'U' qualifier is attached. Contract Required Detection Limit (CRDL) standards are required to demonstrate a linear calibration curve near the CRDL. CRDL standards were run at the required frequency.

13.0 Overall Assessment of the Data

This validation of the data is based on the criteria outlined in the *National Functional Guidelines for Inorganic Data Review (02/94)*. Approximately 29% of the data was qualified based on blank contamination, interference, matrix spike recovery, or poor serial dilution results. The data as qualified is acceptable for all purposes.

Below are the definitions for the National Functional Guidelines for Inorganic Data Review (02/94) qualifiers used when validating/qualifying data from Inorganic analysis.

DATA QUALIFIERS

U - The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

J - The associated value is an estimated quantity.

R - The data are unusable. (Note: Analyte may or may not be

present.)

UJ - The material was analyzed for, but was not detected. The associated value is an estimate and may be inaccurate or imprecise.

For this SDG, bias for the data was qualitatively assessed and if applicable, the following additional qualifiers were applied:

L - Low bias.

H - High bias.

K - Unknown Bias.

EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAK56

Lab Name: SENTINEL INC. Contract: 68-D5-0167

Lab Code: SENTIN Case No.: 27168 SAS No.: SDG No.: MJAK56

Matrix (soil/water): WATER Lab Sample ID: 22333S

Level (low/med): LOW Date Received: 07/03/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	17900			P
7440-36-0	Antimony	7.9	B		P
7440-38-2	Arsenic	710		~~E~~	P
7440-39-3	Barium	10.4	B	~~N~~ JL	P
7440-41-7	Beryllium	4.6	B		P
7440-43-9	Cadmium	1110		~~E~~ JK	P
7440-70-2	Calcium	50600			P
7440-47-3	Chromium	2.3	~~B~~	UJK	P
7440-48-4	Cobalt	351			P
7440-50-8	Copper	1230			P
7439-89-6	Iron	459000			P
7439-92-1	Lead	394			P
7439-95-4	Magnesium	82300			P
7439-96-5	Manganese	83100			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	288			P
7440-09-7	Potassium	948	B		P
7782-49-2	Selenium	44.1		~~N~~ JK	P
7440-22-4	Silver	29.9		~~N~~ JL	P
7440-23-5	Sodium	15100			P
7440-28-0	Thallium	39.7			P
7440-62-2	Vanadium	1.4	U	JK	P
7440-66-6	Zinc	465000			P
	Cyanide				NR

ug/L or mg/kg

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EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAK57

Lab Name: SENTINEL INC. Contract: 68-D5-0167

Lab Code: SENTIN Case No.: 27168 SAS No.: SDG No.: MJAK56

Matrix (soil/water): WATER Lab Sample ID: 22334S

Level (low/med): LOW Date Received: 07/03/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M	
7429-90-5	Aluminum	6570			P	
7440-36-0	Antimony	3.0	U		P	
7440-38-2	Arsenic	234		~~B~~	P	
7440-39-3	Barium	18.6	B	~~N~~ JL	P	
7440-41-7	Beryllium	1.5	B		P	
7440-43-9	Cadmium	387		~~B~~ JK	P	
7440-70-2	Calcium	211000			P	
7440-47-3	Chromium	4.1	~~B~~	UJL	P	
7440-48-4	Cobalt	242			P	
7440-50-8	Copper	439			P	
7439-89-6	Iron	208000			P	
7439-92-1	Lead	521			P	
7439-95-4	Magnesium	231000			P	
7439-96-5	Manganese	181000			P	
7439-97-6	Mercury	0.10	U		CV	
7440-02-0	Nickel	212			P	
7440-09-7	Potassium	8780			P	
7782-49-2	Selenium	38.3		~~N~~ JK JH	P	JL
7440-22-4	Silver	27.3		~~N~~ JL	P	
7440-23-5	Sodium	4010	B		P	
7440-28-0	Thallium	61.5			P	
7440-62-2	Vanadium	1.4	U	JK	P	
7440-66-6	Zinc	186000			P	
_____	Cyanide				NR	JL 11/4 KK

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EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAK58

Lab Name: SENTINEL INC. Contract: 68-D5-0167

Lab Code: SENTIN Case No.: 27168 SAS No.: SDG No.: MJAK56

Matrix (soil/water): WATER Lab Sample ID: 22335S

Level (low/med): LOW Date Received: 07/03/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	101	B		P
7440-36-0	Antimony	3.0	U		P
7440-38-2	Arsenic	3.0	U	~~E~~ JK	P
7440-39-3	Barium	83.2	B	~~N~~ JL	P
7440-41-7	Beryllium	0.40	U		P
7440-43-9	Cadmium	17.9		~~E~~ JK	P
7440-70-2	Calcium	20000			P
7440-47-3	Chromium	1.0	U		P
7440-48-4	Cobalt	14.4	B		P
7440-50-8	Copper	9.3	B		P
7439-89-6	Iron	2360			P
7439-92-1	Lead	767			P
7439-95-4	Magnesium	40400			P
7439-96-5	Manganese	12100			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	18.9	B		P
7440-09-7	Potassium	1150	B		P
7782-49-2	Selenium	2.3	U	~~N~~	P
7440-22-4	Silver	1.4	U	~~N~~ JL	P
7440-23-5	Sodium	915	B		P
7440-28-0	Thallium	3.3	U		P
7440-62-2	Vanadium	1.4	U		P
7440-66-6	Zinc	3700			P
	Cyanide				NR

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EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAK59

Lab Name: SENTINEL INC. Contract: 68-D5-0167

Lab Code: SENTIN Case No.: 27168 SAS No.: SDG No.: MJAK56

Matrix (soil/water): WATER Lab Sample ID: 22336S

Level (low/med): LOW Date Received: 07/03/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	6710			P
7440-36-0	Antimony	3.0	U		P
7440-38-2	Arsenic	237		~~E~~ JK	P
7440-39-3	Barium	19.4	B	~~N~~ JL	P
7440-41-7	Beryllium	1.5	B		P
7440-43-9	Cadmium	401		~~E~~ JK	P
7440-70-2	Calcium	219000			P
7440-47-3	Chromium	3.9	~~B~~	UJK	P
7440-48-4	Cobalt	251			P
7440-50-8	Copper	451			P
7439-89-6	Iron	215000			P
7439-92-1	Lead	534			P
7439-95-4	Magnesium	237000			P
7439-96-5	Manganese	184000			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	221			P
7440-09-7	Potassium	8830			P
7782-49-2	Selenium	41.0		~~N~~ JH	P
7440-22-4	Silver	28.7		~~N~~ JL	P
7440-23-5	Sodium	3900	B		P
7440-28-0	Thallium	66.2			P
7440-62-2	Vanadium	1.4	U	JK	P
7440-66-6	Zinc	188000			P
	Cyanide				NR

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EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAK60

Lab Name: SENTINEL INC. Contract: 68-D5-0167

Lab Code: SENTIN Case No.: 27168 SAS No.: SDG No.: MJAK56

Matrix (soil/water): WATER Lab Sample ID: 22337S

Level (low/med): LOW Date Received: 07/03/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	441		J~~K~~	P
7440-36-0	Antimony	3.0	U		P
7440-38-2	Arsenic	3.0	U	~~B~~ J~~K~~	P
7440-39-3	Barium	21.8	B	~~N~~ J~~L~~	P
7440-41-7	Beryllium	0.40	U		P
7440-43-9	Cadmium	14.7		~~B~~ J~~K~~	P
7440-70-2	Calcium	356000			P
7440-47-3	Chromium	3.9	~~B~~	U J~~K~~	P
7440-48-4	Cobalt	224			P
7440-50-8	Copper	8.9	B		P
7439-89-6	Iron	119000			P
7439-92-1	Lead	571			P
7439-95-4	Magnesium	359000			P
7439-96-5	Manganese	262000			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	207			P
7440-09-7	Potassium	15100			P
7782-49-2	Selenium	58.5		~~N~~ J~~H~~	P
7440-22-4	Silver	36.1		~~N~~ J~~L~~	P
7440-23-5	Sodium	3190	B		P
7440-28-0	Thallium	106			P
7440-62-2	Vanadium	1.4	U	J~~K~~	P
7440-66-6	Zinc	33500			P
_____	Cyanide				NR

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EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAK61

Lab Name: SENTINEL INC. Contract: 68-D5-0167

Lab Code: SENTIN Case No.: 27168 SAS No.: SDG No.: MJAK56

Matrix (soil/water): WATER Lab Sample ID: 22350S

Level (low/med): LOW Date Received: 07/08/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	459			P
7440-36-0	Antimony	3.0	U		P
7440-38-2	Arsenic	3.0	U	~~E~~ J~~K~~	P
7440-39-3	Barium	28.1	B	~~N~~ J~~K~~	P
7440-41-7	Beryllium	0.40	U		P
7440-43-9	Cadmium	6.0		~~E~~ J~~K~~	P
7440-70-2	Calcium	2430	B		P
7440-47-3	Chromium	1.7	~~B~~	U J~~K~~	P
7440-48-4	Cobalt	5.5	B		P
7440-50-8	Copper	3.3	B		P
7439-89-6	Iron	8810			P
7439-92-1	Lead	781			P
7439-95-4	Magnesium	3910	B		P
7439-96-5	Manganese	6000			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	5.6	B		P
7440-09-7	Potassium	830	B		P
7782-49-2	Selenium	2.3	U	~~N~~	P
7440-22-4	Silver	2.1	B	~~N~~ J~~K~~	P
7440-23-5	Sodium	927	~~B~~	U	P
7440-28-0	Thallium	3.3	U		P
7440-62-2	Vanadium	1.4	U		P
7440-66-6	Zinc	1500			P
	Cyanide				NR

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EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAK62

Lab Name: SENTINEL INC. Contract: 68-D5-0167

Lab Code: SENTIN Case No.: 27168 SAS No.: SDG No.: MJAK56

Matrix (soil/water): WATER Lab Sample ID: 22351S

Level (low/med): LOW Date Received: 07/08/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	69.9	~~B~~	UJK	P
7440-36-0	Antimony	3.0	U		P
7440-38-2	Arsenic	3.0	U	~~E~~ JK	P
7440-39-3	Barium	7.0	B	~~NJ~~K	P
7440-41-7	Beryllium	0.40	U		P
7440-43-9	Cadmium	88.0		~~E~~ JK	P
7440-70-2	Calcium	43200			P
7440-47-3	Chromium	1.6	~~B~~	UJK	P
7440-48-4	Cobalt	29.7	B		P
7440-50-8	Copper	4.8	B		P
7439-89-6	Iron	5150			P
7439-92-1	Lead	644			P
7439-95-4	Magnesium	145000			P
7439-96-5	Manganese	74300			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	47.3			P
7440-09-7	Potassium	1520	B		P
7782-49-2	Selenium	5.1		~~N~~JH	P
7440-22-4	Silver	8.9	B	~~N~~JK	P
7440-23-5	Sodium	962	~~B~~	U	P
7440-28-0	Thallium	13.2			P
7440-62-2	Vanadium	1.4	U		P
7440-66-6	Zinc	42200			P
	Cyanide				NR

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INORGANIC ANALYSIS DATA SHEET

EPA SAMPLE NO.

MJAK63

Lab Name: SENTINEL INC. Contract: 68-D5-0167

Lab Code: SENTIN Case No.: 27168 SAS No.: SDG No.: MJAK56

Matrix (soil/water): WATER Lab Sample ID: 22352S

Level (low/med): LOW Date Received: 07/08/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	127	~~B~~	UJK	P
7440-36-0	Antimony	3.0	U		P
7440-38-2	Arsenic	3.0	U	~~E~~ JK	P
7440-39-3	Barium	1.7	~~B~~	U ~~N~~ JK	P
7440-41-7	Beryllium	0.40	U		P
7440-43-9	Cadmium	106		~~E~~ JK	P
7440-70-2	Calcium	47100			P
7440-47-3	Chromium	1.5	~~B~~	UJK	P
7440-48-4	Cobalt	50.9			P
7440-50-8	Copper	3.5	B		P
7439-89-6	Iron	662			P
7439-92-1	Lead	1290			P
7439-95-4	Magnesium	187000			P
7439-96-5	Manganese	178000			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	77.9			P
7440-09-7	Potassium	1870	B		P
7782-49-2	Selenium	24.9		~~N~~ JH	P
7440-22-4	Silver	20.8		~~N~~ JL	P
7440-23-5	Sodium	1280	B		P
7440-28-0	Thallium	53.7			P
7440-62-2	Vanadium	1.4	U		P
7440-66-6	Zinc	48800			P
	Cyanide				NR

09/14/99

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EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAK64

Lab Name: SENTINEL INC. Contract: 68-D5-0167

Lab Code: SENTIN Case No.: 27168 SAS No.: SDG No.: MJAK56

Matrix (soil/water): WATER Lab Sample ID: 22353S

Level (low/med): LOW Date Received: 07/08/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	70.5	~~B~~	UJK	P
7440-36-0	Antimony	3.0	U		P
7440-38-2	Arsenic	3.0	U	~~E~~ JK	P
7440-39-3	Barium	10.0	B	~~N~~ JL	P
7440-41-7	Beryllium	0.40	U		P
7440-43-9	Cadmium	22.2		~~E~~ JK	P
7440-70-2	Calcium	24500			P
7440-47-3	Chromium	1.9	~~B~~	UJK	P
7440-48-4	Cobalt	19.3	B		P
7440-50-8	Copper	2.5	U		P
7439-89-6	Iron	7940			P
7439-92-1	Lead	449			P
7439-95-4	Magnesium	58300			P
7439-96-5	Manganese	69900			P
7439-97-6	Mercury	0.10	U		CV
7440-02-0	Nickel	44.9			P
7440-09-7	Potassium	2010	B		P
7782-49-2	Selenium	5.8		~~N~~ JH	P
7440-22-4	Silver	8.6	B	~~N~~ JL	P
7440-23-5	Sodium	1590	B		P
7440-28-0	Thallium	11.3			P
7440-62-2	Vanadium	1.4	U		P
7440-66-6	Zinc	13000			P
_____	Cyanide				NR

dlc 09/14/99

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

9